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Investigating the readiness of people in manufacturing SMEs to embark on LSS projects

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Purpose – The purpose of this article is to investigate the impact of the core personal competence, vision and organisational culture on readiness of people to commence Lean Six Sigma (LSS) projects in the manufacturing Small and Medium Sized- Enterprises (SMEs).

Design/methodology/approach - A set of hypothesis analysis was designed to identify the level of association between constructs of people's competence, vision and culture with LSS readiness through correlation and regression analysis. A quantitative data collection through questionnaire has been conducted for seven different German manufacturing SMEs involved in aerospace and agro-food manufacturing as convenient samples.

Finding – It was found that there is a strong positive association between Core competence of people and organisational culture with readiness for commencing LSS. However, further detailed regression analysis indicated that amongst cultural constructs, core values of people was the significant predictor for LSS readiness, whilst no significant difference between core competence constructs was found to be ready for LSS commencing. Therefore, focusing on core values of people could be prioritised to facilitate management commitment and removing resistance to change as two key people-related success factors of LSS commencement.

Practical Implications –The result of this paper could be generalised to different manufacturing SMEs and would have direct impact on identifying the key factors that could lead to management commitment and resistance to change in order to commence any LSS in any organisation specially SMEs.

Originality/Value- This research focuses on human resource (HR) aspects of implementing LSS projects in SMEs and would recommend the people-related critical variables to lead success of LSS project in western culture.

Key Words – Lean Six Sigma, Six Sigma, Manufacturing, SMEs, Key success factors, Human Resource

Introduction

LSS is a business improvement strategy that has been blooming within last decade to promote enhanced business performance and therefore more capability in the market. LSS has been adopted by combining two of the most popular tools for performance improvement in 1990s as Six Sigma and Lean (Assarland et al, 2013; Lee et al, 2011; Hilton and Sohal, 2012; and Delgado et al, 2010). It was suggested that resources and cognitive aspects of competencies such as knowledge and skill are the biggest enablers for LSS deployment (Hilton and Sohal, 2012). There has been significant number of research articles in relation to providing critical

success factors (CSFs) of the LSS in manufacturing SMEs with less than 250 employees under EU definition (Kumar et al, 2009) suggesting the top management commitment as the most critical success factor of LSS application (Assarland et al, 2013; Desai et al, 2012; Jayaraman et al, 2012; Lee et al, 2011). The resistance to change or implementation of any continuous improvement initiative has been recommended as one of the key barriers to implement LSS (Assarland et al, 2013 and Delgado, 2010). LSS is a process improvement strategy and heavily dependent on collective individual, team and organisational learning behaviour to create knowledge (Arumugam et al, 2013). Zhang et al, 2012 has highlighted the theory evolution of implementing LSS in SMEs and its integration with HR or people aspects in organisations. Therefore, personal competence, people's vision and culture will influence on the top management commitment and organisational resistance to embark on LSS in manufacturing SMEs. However, apart from very few viewpoint outputs focused on human resource aspects and readiness for the LSS application in service sector (Antony, 2014; Fazzari and Levitt, 2008; and Hensley and Dobie, 2005), a rigorous research evidence can hardly be found about the role of HR factors in promoting readiness and enabling those presented CSFs to apply LSS in manufacturing SMEs.

The purpose of this paper is to investigate the people - related aspect of these two key elements in manufacturing SMEs before commencing any LSS programme. On other hand, it is intended to identify the key human and behavioural aspects of SMEs personnel that can have impact on readiness to embark on LSS. According to Antony, 2014; and Lee et al, 2011, the LSS readiness means awareness of terminology, principle and benefits, eagerness to work in team projects and eagerness to work with data and statistics. These elements have been selected as key constructs of LSS readiness or the methodology of this research. The result of this paper will identify the most important human resource factors that lead to top

management commitment and resistance to change as the platform for successful application of LSS in manufacturing SMEs.

At an operational level in manufacturing sector, the LSS model will aim at clarifying a process towards identifying opportunities to reduce variability and improve quality of the manufacturing process (Thomas et al, 2009). LSS is primarily a systematic and rigorous tool with top-down approach to discover and reduce variation and waste through breakthrough or continuous improvement projects to improve quality, efficiency and speed in both service and manufacturing (Antony, 2014; Brianvand and Khasseh, 2013; Hilton and Sohal, 2012; Assarlind et al, 2013 and Manville et al, 2012). LSS projects focus on customer needs, financial enhancement (Shafer and Moeller, 2012; and Cournoyer et al, 2012), improved efficiency (Jayaraman et al, 2012) and process improved cycle time (Gupta et al, 2012) by reducing the variation in process, reducing non-value adding activities, better decision making and more employee morale (Manville, 2012; Thomas et al, 2009; Biranvand and Khasseh, 2013) in manufacturing SMEs (Thomas et al, 2009; Gijo, 2014; and Cournoyer, 2012). LSS utilises a five-phased systematic methodology of DMAIC (Define, Measure, Analysis, Improve, Control), which applied to tackle specific problems (Gupta et al, 2012).

LSS in manufacturing SMEs

There has been growing number of research outputs highlighting the role of LSS or Six Sigma in SMEs to improve quality, cost efficiency and profitability as the prime objectives in SMEs (Kaushik et al, 2012; Kumar et al, 2011; Antony, 2008; and Thomas et al, 2009) considering resource management and cost-effectiveness (Thomas et al, 2009). Further research studies have suggested that LSS or Six Sigma application in SMEs needs different views in comparison with larger organisations in relation to resources and human resource aspects such as training (Kumar et al, 2013; Kaushik et al, 2012; Kumar et al, 2011, Thomas

and Barton, 2006; Nabhnai and Shokri, 2009). The LSS research in manufacturing SMEs has been predominantly related to practical aspects such as DMAIC methodology rather than more strategic perspective (Kaushak et al, 2012; Thomas et al, 2009; and Antony et al, 2005). People orientation has been suggested as one of the key fundamental factors to enhance SME ability to implement LSS (Antony et al, 2005) , whilst SMEs are currently suffering from lack of knowledge and confidence in using technical and statistical tools (Thomas and Barton, 2006).

The literature has suggested top management support, leadership, training and cultural change as main people-oriented success factors in manufacturing SMEs (Kumar et al, 2009; Nakhaie and Neves, 2009; and Kumar and Antony, 2008). Resistance to change and poor organisational culture have been presented amongst key barriers in manufacturing SMEs to implement LSS (Aboelmajed, 2011; and Kumar and Antony, 2008). Hilton and Sohal (2012) highlighted the competence of the workforce, vision of the people and culture of the organisation as key enablers of the successful deployment of LSS. This would support the idea of investigating the level of relationship between core personal competence, vision of people and organisational culture with readiness to embark on LSS in manufacturing SMEs.

Hypothesis Development

Core Personal Competence and readiness for LSS

The first priority of any quality strategy must be to build quality and innovation into people and improve personal competence including technical knowledge and charisma as the essential catalyst to evolve LSS and improve processes and products (Maleyeff et al, 2012; Hilton and Sohal, 2012; and Dahlgaard and Dahlgaard-Park, 2006). Core competences, which include emotional competences (EC) and intellectual competences (IC), comprise the

capabilities needed to satisfy human's mental needs and successfully embark on LSS (Cherniss et al, 2010; and Dahlgaard and Dahlgaard-Park, 2006).

EC refer to human sensibility and consist of self-awareness, self-regulation, self-motivation, empathy and socialism (Dahlgaard and Dahlgaard-Park, 2006). Jarayaman et al, 2012 has introduced self-awareness as a critical drive for LSS in any organisation. In contrast to the EC, IC refer to human capabilities, which involve rational and reasoning capabilities such as training, education and performance management (Dahlgaard and Dahlgaard-Park, 2006). Comprehensive training (Kumar et al, 2011; Antony et al, 2005; Zu et al, 2009; and Arnheiter and Maleyeff, 2005) and knowledge development (Maleyeff et al, 2012) have been introduced as key success factors in LSS deployment for any organisation, while Aboelmaged, 2011 has highlighted the knowledge barrier as the most critical barrier factor which results in failure to accept change and also implement LSS. Finding and maintaining high quality employees through appraisal and performance management to implement or adopt Total Quality Management (TQM) culture and therefore prepare for any quality improvement practice has been highlighted by the literature (Abu-Doleh, 2012 and McElwee and Warren, 2000). Therefore, the impact of core personal competence on readiness for LSS in manufacturing SMEs can be investigated through below hypothesis:

H1: Core personal competence of people in manufacturing SMEs will positively affect the readiness for embarking on LSS

Strategic and operational vision and readiness for LSS

Linking LSS to principles of quality improvement philosophy of TQM (Dahlgaard and Dahlgaard-Park, 2006), organisation vision (Pamfilie et al, 2012) and also to short-term and long-term business strategies (Cheng, 2013; and Maleyeff et al, 2012) has been acknowledged by the literature. This would encourage the researchers to evaluate the vision

of the people as the enabler for implementing LSS or any other business excellence quality model (Alonso-Almeida and Fuentes-Frias, 2012). Vision for process improvement and problem solving methodology has been indicated as the key construct of assessing link between business strategy and LSS (Cheng, 2013; and Zu and Fredendall, 2009). Quick fix expectation and inadequate long-term commitment towards continuous improvement (CI) have been recognised as key individual's visions to deter organisations of implementing LSS (Gupta et al, 2012; Antony, 2011; and Cournoyer et al, 2012). The vision of people towards principles of TQM philosophy will distinguish them to select the best possible business excellence practice (Dahlgaard and Dahlgaard-Park, 2006). This would support the importance of identifying the people's understanding about the strategic directions and the key performance indicators inside the organisation in order to prepare them for any quality excellence practice. LSS practitioners view any non-value adding activity as opportunity for defect and problem solving in LSS quality excellence vision (Antony, 2011; and Atmaca and Girenes, 2013). Therefore, the impact of vision on readiness for LSS in manufacturing SMEs can be investigated through below hypothesis:

H2: Strategic and operational vision of people in manufacturing SMEs will positively affect the readiness for embarking on LSS

Organisational Culture and readiness for LSS

An appropriate organisational culture has been widely considered as necessity for any TQM practice including LSS (Antony, 2014, Zu et al, 2010 and Mosadegh rad, 2006). Moreover, organisational culture has been recognised as moderator between CSFs and LSS implementation in manufacturing industries (Jayaraman et al, 2012). Collaboration as one of the common factors of corporate organisational culture will support the successful implementation of any TQM practice (Mosadegh Rad, 2006). People recognition through empowerment, inspiration and involvement in decision making processes has been

introduced as an important construct of successful LSS implementation (Antony, 2014; Hilton and Sohal, 2012; and Zu, 2009). It had even been emphasised as a critical human resource enabler to promote organisational readiness in SMEs (McElwee and Warren, 2000).

Moreover, the significant link has been found between people recognition and leadership as a key TQM enabler (Yunis et al, 2013) to facilitate readiness for LSS (Antony, 2014). It was reflected by Manville et al, 2012 that leadership style will facilitate the organisational change initiatives to embark on LSS. Furthermore, organisational responsibility to bring change and promote excitement has been found as a critical element in LSS deployment (Manville et al, 2012). It was indicated by literature that establishment of quality– orientation culture is a necessary element before potential application of LSS (Hensley and Dobie, 2005; and Arnheiter and Maleyeff, 2005). However, it was emphasised by the literature that focus on spiritual values called as core values such as trust, respect, integrity, loyalty, justice and honesty is critical to utilise the other organisational culture elements and also core competence to promote organisational excellence through LSS (Dahlgaard and Dahlgaard-Park, 2006). Therefore, the impact of organisational culture on readiness for LSS in manufacturing SMEs can be investigated through below hypothesis:

H3: Organisational culture of people in manufacturing SMEs will positively affect the readiness for embarking on LSS

Figure 1 represents the hypothesis testing model in order to identify the significance of the relationship between those three elements and their constructs with LSS readiness in western European manufacturing SMEs.

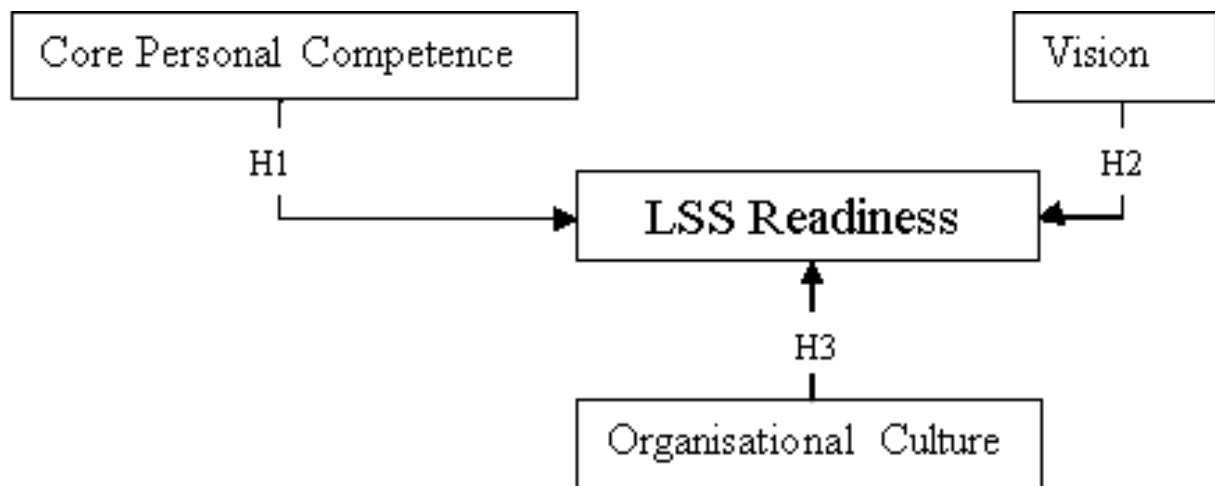


Figure 1 – Hypothesis model for the research methodology

Research Methodology

This section aims to provide useful information about data collection, sampling and data analysis techniques to investigate the level of impact of three people – related constructs as independent factors on LSS readiness constructs as dependent factors. It was decided to use structured survey through purposive sampling technique with using simple terminologies in questions as a quantitative and deductive data collection instrument, which is suitable to investigate the relationship between two variables (Saunders et al, 2012). Three German agro-food SMEs with average forty employees and four aerospace manufacturing SMEs with average hundred employees have been selected for data collection.

It was decided to use both correlation and regression analysis in order to investigate the relationship between constructs in more details. Constructs have been presented mainly with dummy variables that are distinguished with *zero* and *one* to represent selecting or not selecting the variable (Field, 2009), although there have been some constructs with categorical data represented numerically. Table 1 provides the variables and their type for each construct of enablers. All of these constructs and their variables have been extracted as

the result of extensive literature review through LSS and Six Sigma papers in conjunction with CSFs, manufacturing SMEs, TQM and HR.

As the result of intensive literature review (Antony, 2014; and Lee et al, 2011), it was decided to construct the LSS readiness through three different factors including eagerness to work in problem solving teams, eagerness to work with data and statistics and awareness of LSS or Six Sigma.

Enablers	Construct	Variables	Type of variables
Core Personal Competence	Education	Doctorate, Master, Bachelor, HND, A-Level, less than A-Level	Numerical
	Emotional Competence	Self-awareness, self-regulation, self-motivation, emphatic, social	Dummy
	Performance Management	In-house training, short courses, regular appraisal	Dummy
Strategic and Operational Vision	Vision for quality improvement term	Quick fix, long term, continuous improvement	Dummy
	Vision for Waste	Inventory, over production, over processing, waiting time, manufacture - to - stock, guarantee, final product inspection, skill miss-utilisation, defective product, machine set-up time, excessive staff movement, customer complaint department	Dummy
	Vision for KPIs	Quality, cost, flexibility, reliability, speed, innovation, safety, profit	Dummy
	Vision for problem solving methodology	No procedure required, statistical approach is required, cross-functional involvement, systematic methodology is required	Dummy
	Vision for most suitable quality initiatives	ISO9000, TQM, Lean, LSS, none	Dummy
Organisational Culture	Collaboration	Depth of collaboration, range of collaboration	Numerical
	Employee Recognition	Involvement in decision making, rewards, willingness to participate, fear factor	Dummy
	Leadership style	Dictatorial, democratic, participative, goal-oriented, situational	Numerical
	Vision and feeling for Change initiation	Rewarding, Exciting, Fearful, hateful	Dummy
	Core Values	Dignity, trust, goodness, loyalty, honesty, justice, respect	Dummy

Table 1 – Constructs and their variables for each hypothesis

Finding and analysis

Having circulated the survey to all managers and employees of seven manufacturing SMEs in Germany through mail or physical distribution, 112 responds were received representing 23%

of total working personnel in these organisations. Figure 2 depicts some descriptive statistics about departments, positions and experience of the respondents.

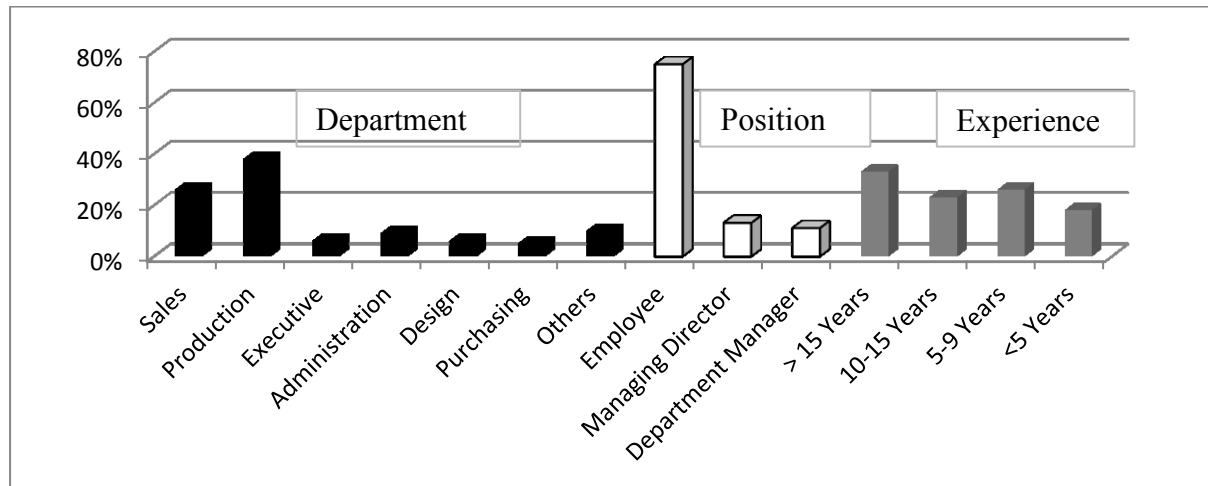


Figure 2 – Organisational descriptive statistics for seven respondents

Table 2 presents the result of correlation coefficient analysis that was extracted from data analysis through SPSS statistical software. The correlation coefficient will recommend the degree of relationship between variables. The result of overall correlation analysis presented by the correlations matrix in table 2 found significant positive relationship between core personal competence of personnel and their readiness to embark LSS with correlation coefficient of $r = 0.552$ at $p < 0.01$. It was also found that There is a significant positive relationship between organisational culture of personnel and their readiness to embark LSS with correlation coefficient of $r = 0.566$ at $p < 0.01$. In contrast, no significant relationship between strategic and operational vision of personnel with their readiness for embarking on LSS has been found. This has encouraged researchers to explore more details about the level of impact from constructs of core personal competence and organisational culture as predictor variables on LSS readiness as an outcome variable through regression analysis.

Correlations

			Core Personal Competence	Vision	Culture	LSS
Spearman's rho	Core Personal Competence	Correlation Coefficient	1.000	.101**	.297**	.552**
		Sig. (2-tailed)	.	.000	.000	.000
		N	1232	1232	1232	336
	Vision	Correlation Coefficient	.101**	1.000	.015	-.056
		Sig. (2-tailed)	.000	.	.497	.310
		N	1232	3584	2015	336
	Culture	Correlation Coefficient	.297**	.015	1.000	.566**
		Sig. (2-tailed)	.000	.497	.	.000
		N	1232	2015	2015	336
	LSS	Correlation Coefficient	.552**	-.056	.566**	1.000
		Sig. (2-tailed)	.000	.310	.000	.
		N	336	336	336	336

** . Correlation is significant at the 0.01 level (2-tailed).

Table 2 – Matrix of correlation analysis

The result of regression analysis on level of impact between core personal competence and LSS readiness has suggested there is an acceptable significant impact of personal core competence constructs on LSS readiness at $p < 0.01$. However, no significant difference was found through a multiple regression analysis between education, emotional competence and performance management as constructs of the core personal competence as predictors for LSS readiness (table 3). This means that none of these factors have priority to be focused in order to enhance LSS readiness through improving core personal competence of the personnel.

It was also found from simple regression analysis that there is an acceptable significant impact of organisational culture on LSS readiness at $p < 0.01$. The result of multiple regression analysis has suggested that “core values” construct as one of the predictor variables of the organisational culture has significant priority to maintain LSS readiness at $p < 0.05$, and the rest of constructs had no significant priority to others (table 4). This means

that focusing on improving “core values” of the personnel could be considered as priority to maintain the readiness of the people for LSS.

Parameter Estimates

LSS ^a	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp (B)	
							Lower Bound	Upper Bound
.00 Intercept	-2.407	1.261	3.645	1	.056			
Education Vs LSS	.107	.180	.349	1	.555	1.112	.781	1.584
Emotional Competence Vs LSS Vs	.026	.823	.001	1	.975	1.027	.205	5.148
Performance Management Vs LSS	-.353	.592	.355	1	.551	.703	.220	2.244

a. The reference category is: 1.00.

Table 3 – Multiple Regression Analysis of impact level of core personal competence variables on LSS readiness

Parameter Estimates

LSS ^a	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp (B)	
							Lower Bound	Upper Bound
.00 Intercept	-1.966	.957	4.222	1	.040			
Collaboration Vs LSS	.001	.169	.000	1	.994	1.001	.719	1.393
Recognition Vs LSS	-.892	.653	1.864	1	.172	.410	.114	1.475
Leadership Vs LSS	.024	.242	.010	1	.920	1.025	.638	1.646
Change Vs LSS	-.373	.647	.333	1	.564	.688	.193	2.449
CoreValues Vs LSS	1.548	.627	6.091	1	.014	4.704	1.375	16.088

a. The reference category is: 1.00.

Table 4 – Multiple Regression Analysis of impact level of organisational culture variables on LSS readiness

The result of simple regression analysis about impact of vision of personnel on LSS readiness was consistent with correlation coefficient analysis presented in table 2 and no significant impact of people’s vision on LSS readiness was found.

Conclusion and future work

The result of this research study has been extracted from a systematic empirical data collection about HR factors that lead to CSFs for commencing LSS in manufacturing SMEs.

This study has gone deeper than existing literature in analysing the HR - related CSFs of

implementing LSS in manufacturing SMEs. Nonetheless, the existing research studies for LSS application in manufacturing SMEs would mainly focus on technical and methodological aspects of LSS and CSFs for LSS application. It was concluded that various quality and waste reduction visions of people would not deter people to embark on LSS implementation in manufacturing SMEs, since no relationship has been found between people's vision and readiness for LSS. In contrast, enhancing core personal competence and organisational culture in manufacturing SMEs will be strong enablers to increase top management commitment and minimise resistance to change to embark on LSS. However, managers and policy makers for manufacturing SMEs would require maintaining their and personnel's core values of dignity, trust, goodness, loyalty, honesty, justice and respect and transforming people's quality in these aspects as the first priority to lead to CSFs of LSS.

The result of this study could be generalised and there is opportunity for further research using the key findings of this study to investigate the role of human resource factors to lead human – related CSFs of LSS commencement in other sectors and countries. This specific research study could also be extended to further analysis in relation to inter- comparison of two different manufacturing SMEs or between two different countries. It would have also been more beneficial to increase the number of case study organisations in order to increase the respondents for this quantitative study.

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